CLAIMS

1. A planarizing medium for planarizing microelectronic substrates, comprising:

a planarizing film impervious to a solution; and

a plurality of micro-features configured in a selected, duplicated pattern on the film, the selected pattern having a plurality of first raised features defining support points, at least one cavity below the support points, and a plurality of second raised features between and below the support points.

2. The planarizing medium of claim 1 wherein the film is composed of a substantially incompressible polymer and the first and second raised features are formed from the film.

3. The planarizing medium of claim 2 wherein the polymer comprises polyester.

4. The planarizing medium of claim 2 wherein the copolymer comprises polycarbonate.

5. The planarizing medium of claim 2 wherein the polymer comprises polyurethane.

6. The planarizing medium of claim 2 wherein the polymer comprises nylon.

7. The planarizing medium of claim 2 wherein the first and second raised features comprise nodules having a plurality of shapes and heights, the nodules being patterned on the film to form a plurality of depressions between the nodules and so that at least a portion of the nodules define the support points.

8. The planarizing medium of claim 7 wherein the first raised features have flat tops terminating at a constant maximum height across the planarizing surface of the film.

9. The planarizing medium of claim 7 wherein the nodules are embossed on the film.

10. The planarizing medium of claim 9 wherein the selected pattern is substantially random configuration of nodules across an operating region of the planarizing surface.

11. The planarizing medium of claim 10 wherein the polymer comprises polyester.

12. The planarizing medium of claim 10 wherein the copolymer comprises polycarbonate.

13. The planarizing medium of claim 1 wherein:

the film comprises a polymer body with an upper surface; and

the micro-features comprise a fine mesh on the upper surface of the film having woven strands, the first raised features being high points along the strands and the second raised features being side portions of the strands.

14. The planarizing medium of claim 13 wherein:

the polymer comprises polyester; and

the fine mesh comprises small nylon fibers woven in a mesh with 0.5% to 5% openings.

15. The planarizing medium of claim 14 wherein the nylon fiber comprise 2.0 μm to 5.0 μm fibers.

16. The planarizing medium of claim 1 wherein the film comprises a flexible web wrapped around a supply roller and a take-up roller, and wherein the pattern of micro-features is duplicated across the web.

17. The planarizing medium of claim 16 wherein a first portion of the web is held at a work station of a planarization machine to planarize a first substrate, and the web is subsequently advanced to position a second portion of the web at the work station to planarize a second substrate.

18. The planarizing medium of claim 1 wherein the planarizing film comprises a separate sheet removably attached to a work station of a planarization machine.

19. A planarizing medium for planarizing a microelectronic substrate, comprising:

an impermeable planarizing film; and

a plurality of non-abrasive micro-features on the planarizing film defining a planarizing surface, the micro-features being formed in a defined, consistently reproduced pattern on the planarizing film to contain planarizing solution between the micro-features and under the substrate during planarization.

20. The planarizing medium of claim 19 wherein the film is composed of a substantially incompressible polymer and the micro-features are formed from the film.

21. The planarizing medium of claim 20 wherein the micro-features comprise nodules having a plurality of shapes and heights, the nodules being patterned on the film to form a plurality of depressions between the nodules that entrap the solution.

22. The planarizing medium of claim 20 wherein a portion of the nodules have flat tops terminating at a constant maximum height across the planarizing surface of the film.

23. The planarizing medium of claim 20 wherein the nodules are embossed on the film.

24. The planarizing medium of claim 20 wherein the depressions are etched into the film.

25. The planarizing medium of claim 20 wherein the selected pattern is substantially random configuration of nodules across an operating region of the planarizing surface.

26. The planarizing medium of claim 19 wherein:

the film comprises a polymer body with an upper surface; and

the micro-features comprise a fine mesh on the upper surface of the film.

27. The planarizing medium of claim 19 wherein the film comprises a flexible web wrapped around a supply roller and a take-up roller, wherein the selected pattern of micro-features is duplicated across the web.

28. The planarizing medium of claim 27 wherein a first portion of the web is held at a work station of a planarizing machine to planarize a first substrate, and the web is subsequently advanced to position a second portion of the web at the work station to planarize a second substrate.

29. The planarizing medium of claim 19 wherein the planarizing film comprises a separate sheet removably attached to a work station of a planarizing machine.

30. The planarizing medium of claim 19 wherein the film comprises polyester.

31. The planarizing medium of claim 19 wherein the film comprises polycarbonate.

32. The planarizing medium of claim 19 wherein the film comprises polyurethane.

33. The planarizing medum of claim 19 wherein the film comprises nylon.

34. A planarizing medium for planarizing a microelectronic substrate, comprising:

a support base positionable on a planarizing machine; and

a separate non-abrasive, incompressible planarizing film positioned on the base, the planarizing film having a plurality of micro-features configured in a selected pattern on the film for restraining fluid flow of a solution across a planarizing surface of the film, the selected pattern being reproduced from a master pattern of micro-features so that the planarizing medium may be duplicated.

35. The planarizing medium of claim 34 wherein the film comprises a flexible web wrapped around a supply roller and a take-up roller, and wherein a portion of the web extending between the supply and take-up rollers is held over the base.

36. The planarizing medium of claim 35 wherein the web is held stationary over the base during planarization by tensioning the web between the supply and take-up rollers.

37. The planarizing medium of claim 34 wherein the film comprises a separate sheet removably attached to the base.

38. The planarizing medium of claim 37 wherein the sheet is clamped to the base under tension.

39. The planarizing medium of claim 34 wherein the base comprises an incompressible plate.

40. The planarizing medium of claim 34 wherein the film is composed of a substantially incompressible polymer and the micro-features are formed from the film.

41. The planarizing medium of claim 34 wherein the micro-features comprise nodules having a plurality of shapes and heights, the nodules being patterned on the film to form a plurality of depressions between the nodules that entrap the solution.

42. The planarizing medium of claim 41 wherein a portion of the nodules have flat tops terminating at a constant maximum height across the planarizing surface of the film.

43. The planarizing medium of claim 41 wherein the nodules are embossed on the film.

44. The planarizing medium of claim 41 wherein the depressions are etched into the film.

45. The planarizing medium of claim 41 wherein the selected pattern is substantially random configuration of nodules across an operating region of the planarizing surface.

46. The planarizing medium of claim 34 wherein:
the film comprises a polymer; and
the micro-features comprises a fine mesh on the film.

47. A planarizing machine, comprising:
a table with a support base;
a planarizing medium having a planarizing film and a plurality of micro-features on the film configured in a selected, repeated pattern, the pattern having a plurality of first raised features defining support points, at least one cavity below the support points, and a plurality of second raised features between and below the support points; and
a carrier assembly having a substrate holder positionable over the film, wherein at least one of the film and the holder moves to translate a substrate across the film during planarization.

48. The planarizing machine of claim 47 wherein the film is composed of a substantially incompressible polymer and the micro-features are formed from the film.

49. The planarizing machine of claim 48 wherein the micro-features comprise nodules having a plurality of shapes and heights, the nodules being patterned on the film to form a plurality of depressions between the nodules that entrap the solution.

50. The planarizing machine of claim 48 wherein a portion of the nodules have flat tops terminating at a constant maximum height across the planarizing surface of the film.

51. The planarizing machine of claim 48 wherein the nodules are embossed on the film.

52. The planarizing machine of claim 48 wherein the depressions are etched into the film.

53. The planarizing machine of claim 48 wherein the selected pattern is substantially random configuration of nodules across an operating region of the planarizing surface.

54. The planarizing machine of claim 47 wherein:
the film comprises a polymer; and
the micro-features comprises a fine mesh on the film.

55. The planarizing machine of claim 47 wherein:
the film comprises a flexible web upon which the selected pattern of micro-features is duplicated; and
the planarizing machine further comprises a supply roll around which an unused part of the web is wound and a take-up roll around which a used part of the web is wound, the supply and take-up rolls selectively advancing the web to position desired portions of the web over the base, and the web being selectively tensioned between the supply and take-up rolls to hold the web stationary during planarization.

56. The planarizing machine of claim 47 wherein the planarizing film comprises a plurality of separate sheets removably attached to the base, wherein each sheet has the selected pattern of micro-features.

57. A planarizing medium for planarizing microelectronic substrates, comprising:

a disposable mono-layer planarizing film having a thickness of between approximately 0.0005 and 0.050 inches and a planarizing surface with a plurality of micro-features, the plurality of micro-features defining fine depressions across the planarizing surface having depths between 0.5 and 100 μm.

58. The planarizing medium of claim 57 wherein the film comprises a flexible web adapted to be wrapped around a supply roller and a take-up roller so that the web may be indexed across a planarizing station of a planarizing machine.

59. The planarizing medium of claim 58 wherein the web comprises a polymer material.

60. The planarizing medium of claim 59 wherein the polymer material comprises polyester.

61. The planarizing medium of claim 59 wherein the polymer material comprises polycarbonate.

62. The planarizing medium of claim 59 wherein the polymer web has a thickness approximately between 0.0005 and 0.003 inches.

63. The planarizing medium of claim 62 wherein the depths of the depressions formed by the micro-features is approximately between 1 and 10 μm.

64. The planarizing medium of claim 63 wherein the web has a plurality of sections and each section has an identical pattern of micro-features.

65. The planarizing medium of claim 57 wherein the film comprises a sheet adapted to be attached to a planarizing station of a planarizing machine.

66. The planarizing medium of claim 65 wherein the sheet comprises a polymer material.

67. The planarizing medium of claim 66 wherein the polymer material comprises polyester.

68. The planarizing medium of claim 66 wherein the polymer material comprises polycarbonate.

69. The planarizing medium of claim 66 wherein the copolymer sheet has a thickness approximately between 0.0005 and 0.003 inches.

70. The planarizing medium of claim 69 wherein the depths of the depressions formed by the micro-features is approximately between 1 and 10 μm.

71. The planarizing medium of claim 70 wherein the sheet has a plurality of sections and each section has an identical pattern of micro-features.

72. The planarizing medium of claim 57 wherein the depths of the depressions formed by the micro-features is approximately between 0.5 μm and 10 μm.

73. A method of planarizing a microelectronic substrate, comprising:

engaging the substrate with a planarizing medium;

moving at least one of the substrate and the medium with respect to the other to translate the substrate across a planarizing surface of the medium; and

restraining fluid flow of a solution under the substrate with raised features that do not contact the substrate as the substrate translates across the planarizing surface to maintain a substantially contiguous distribution of solution under the substrate.

74. The method of claim 73 wherein restraining fluid flow of the solution step comprises:

providing a planarizing medium including a film impervious to the solution and a plurality of micro-features configured in a selected pattern on the film that entrap small volumes of solution under the substrate while the substrate translates across the planarizing surface; and

depositing the solution onto the film.

75. The method of claim 74 wherein the planarizing medium comprises a first portion and a second portion, the selected pattern being duplicated on the first and second portions, and wherein the method further comprises:

engaging a first substrate with the first portion;

moving at least one of the first substrate and the first portion with respect to the other to translate the first substrate across a planarizing surface of the first portion;

replacing the first portion with the second portion after planarizing the first substrate;

engaging a second substrate with the second portion;

moving at least one of the second substrate and the second portion with respect to the other to translate the second substrate across a planarizing surface of the second portion.

76. The method of claim 75 wherein:

the first and second portions are formed together in a continuous web; and

replacing the first portion with the second portion comprises advancing the web to remove the first portion from a base of a planarizing machine and to position the second portion on the base.

77. The method of claim 75 wherein:

the first and second portions are separate sheets; and

replacing the first portion with the second portion comprises unclamping the first portion from a base of a planarizing machine, removing the first portion from the base, positioning the second portion on the base, and clamping the second portion on the base.

78. The method of claim 74 wherein:

the film is composed of a substantially incompressible polymer and the micro-features comprise a plurality of nodules formed from the film, the nodules having a plurality of different shapes and heights; and

the method further comprises preparing the medium for planarization prior to engaging the substrate with the medium by flattening a portion of the nodules at a maximum height across the planarizing surface.

79. The method of claim 78 wherein flattening a portion of the nodules comprises planarizing a sacrifice substrate on medium.

80. A method of planarizing a microelectronic substrate, comprising:

engaging the substrate with a planarizing medium including a film impervious to the solution and a plurality of micro-features configured in a selected pattern on the film;

moving at least one of the substrate and the medium with respect to the other to translate the substrate across a planarizing surface of the medium;

supporting the substrate with at least a portion of the micro-features having the greatest heights; and

entrapping small volumes of solution between the micro-features and under the substrate as the substrate translates across the planarizing surface.

81. The method of claim 80 wherein entrapping small volumes of the solution step comprises:

configuring the selected pattern of micro-features on the film to inhibit fluid flow of the solution under the substrate as the substrate translates across the planarizing surface; and

depositing the solution onto the film.

82. The method of claim 81 wherein the planarizing medium comprises a first portion and a second portion, and wherein the method further comprises:

engaging a first substrate with the first portion;

moving at least one of the first substrate and the first portion with respect to the other to translate the first substrate across a planarizing surface of the first portion;

replacing the first portion with the second portion after planarizing the first substrate;

engaging a second substrate with the second portion;

moving at least one of the second substrate and the second portion with respect to the other to translate the second substrate across a planarizing surface of the second portion.

83. The method of claim 82 wherein:

the first and second portions are formed together in a continuous web; and

replacing the first portion with the second portion comprises advancing the web to remove the first portion from a base of a planarizing machine and to position the second portion on the base.

84. The method of claim 82 wherein:

the first and second portions are separate sheets; and

replacing the first portion with the second portion comprises unclamping the first portion from a base of a planarizing machine, removing the first portion from the base, positioning the second portion on the base, and clamping the second portion on the base.

85. The method of claim 81 wherein:

the film is composed of a substantially incompressible polymer and the micro-features comprise a plurality of nodules formed from the film, the nodules having a plurality of different shapes and heights; and

the method further comprises preparing the medium for planarization prior to engaging the substrate with the medium by flattening a portion of the nodules at a maximum height across the planarizing surface.

86. The method of claim 85 wherein flattening a portion of the nodules comprises planarizing a sacrifice substrate on medium.

87. A method of planarizing a microelectronic substrate, comprising:

depositing a planarizing solution onto a planarizing medium having a film impervious to the solution and a planarizing surface with a plurality of micro-features, the micro-features being configured in a selected pattern to entrap a volume of the solution between the micro-features, and the selected pattern being reproduced from a master pattern of micro-features so that the planarizing medium may be duplicated;

engaging the substrate with the planarizing surface; and

moving at least one of the substrate and the medium with respect to the other to translate the substrate across a planarizing surface of the medium.

88. The method of claim 87 wherein the planarizing medium comprises a first portion and a second portion, the selected pattern being duplicated on the first and second portions, and wherein the method further comprises:

engaging a first substrate with the first portion;

moving at least one of the first substrate and the first portion with respect to the other to translate the first substrate across a planarizing surface of the first portion;

replacing the first portion with the second portion after planarizing the first substrate;

engaging a second substrate with the second portion;

moving at least one of the second substrate and the second portion with respect to the other to translate the second substrate across a planarizing surface of the second portion.

89. The method of claim 88 wherein:

the first and second portions are formed together in a continuous web; and

replacing the first portion with the second portion comprises advancing the web to remove the first portion from a base of a planarizing machine and to position the second portion on the base.

90. The method of claim 88 wherein:

the first and second portions are separate sheets; and

replacing the first portion with the second portion comprises unclamping the first portion from a base of a planarizing machine, removing the first portion from the base, positioning the second portion on the base, and clamping the second portion on the base.

91. The method of claim 87 wherein:

the film is composed of a substantially incompressible polymer and the micro-features comprise a plurality of nodules formed from the film, the nodules having a plurality of different shapes and heights; and

the method further comprises preparing the medium for planarization prior to engaging the substrate with the medium by flattening a portion of the nodules at a maximum height across the planarizing surface.

92. The method of claim 91 wherein flattening a portion of the nodules comprises planarizing a sacrifice substrate on medium.

93. A method of manufacturing microelectronic substrate polishing pads, comprising:

forming a defined pattern of non-abrasive micro-features on a planarizing surface of a first portion of a film impervious to a planarizing solution; and

duplicating the defined pattern of micro-features on a planarizing surface of a second portion of the film.

94. The method of claim 93 wherein:

the film comprises a polymer; and

forming the defined pattern of micro-features on the first portion of film comprises providing a die having a plurality of recesses arranged in the defined pattern to form a plurality of first and second raised features, and embossing the first portion of film with the die to form the defined pattern of first and second raised features on the surface of the film.

95. The method of claim 94 wherein duplicating the defined pattern of micro-features on the second portion of film comprises embossing the second portion of film with the die to duplicate the defined pattern of first and second raised features on the surface of the film.

96. The method of claim 93 wherein:

the film comprises a polymer; and

forming the defined pattern of micro-features on the first portion of film comprises attaching a portion of fine mesh of woven strands to the first portion of film.

97. The method of claim 96 wherein duplicating the defined pattern of micro-features on the second portion of film comprises attaching another portion of the fine mesh of woven strands to the second portion of film.

98. The method of claim 96 wherein

the film comprises a polymer; and

forming the defined pattern of micro-features on the first portion of film comprises etching the film through a master pattern to from a plurality of first and second raised features across the surface of the film.

99. The method of claim 98 wherein etching the film comprises:

forming a protective layer on the film having openings corresponding to depressions between the first and second raised features; and

etching the film through the openings.

100. The method of claim 98 wherein duplicating the defined pattern of micro-features on the second portion of film comprises duplicating the master pattern on the second portion of film and etching the film through the duplicated master pattern to from a plurality of first and second raised features across the surface of the film.